



TECHNOGENIC TRANSFORMATIONS OF SEA COASTS ON THE EXAMPLE OF THE BALTIC SEA

N.A. Bogdanov¹⁺ — A.N. Paranina²

¹*Institute of Geography, Russian Academy of Sciences, Moscow Russia*

²*Herzen State Pedagogical University of Russia, St. Petersburg Russia*

ABSTRACT

Natural and technogenic factors of violation of natural development of the Liepaja sandy rersash in Southeast Baltic are considered. Along coast for many years there has been a stream of substance and energy, unidirectional to the North. At the beginning of the 20th century after the reconstruction of the Russian port of Libava and lengthening of piers for more than 2 km, a stop of sea deposits along the coast appeared. It caused catastrophic local washout of the coast and bottom. In result, territorial losses, beach titanium-zirconium rerash, different types of pollution appeared. By a research it was established: 1. Rate of abrasion (20th century the coast receded to 200 m); 2. Formation and dynamics of the centers of concentration of heavy minerals, is defined amount of the useful ore minerals in a productive size of beach sands (0,2-0,25 mm, an ilmenite, a magnetite, zircon, rutile, a monocyte, leucoxene; 74% or 1523 kg/m³); 3. Major factors of change of a condition of coast and bottom of the sea. Also an assessment of consequences is given to events of World War II and on the Chernobyl NPP. Illustrations of the article show localization of concentrates of heavy minerals in a ledge of washout of the coast and on the beach, and also structure of mean annual coastal streams of substance and wave energy in technogenic morpholytho-dynamic anomaly at the port of Liepaja.

Keywords: Technogenic streams, Destruction of coast, Pollution, Ecological state, Baltic sea, Port of Liepaja.

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1. INTRODUCTION

The researches of technogenic transformation of sea coasts presented in article rely on traditions of the Russian researches (Aibulatov, 2000; Aibulatov, 2005). At the beginning of the XX century the anthropogenic factor disrupted natural development of the Liepaja Litorinal spit in the South-Eastern Baltic, along the shores of which in the north of the cape Mietrags unidirectional flow of matter and energy existed (Bogdanov, 1993). The consequences of such an intervention expressed in territorial losses (catastrophic abrasion) and in the aspects of mineral resource (beach placer formation) and environmental hygiene (all sorts of pollution).

2. ABRASION OF THE SHORE

In Courland, on the outskirts of Libau by the decree of Peter the Great a port (edge of XVII-XVIII centuries) was founded. Paired cribed moles of riprap sunk in waters of 320 meters. The approaches to port were sanded and it forces to extend them to a depth of 6 m (1868). At the edge of XIX-XX centuries port expanded and strengthened the fortress. Forts were built at 70-100 m from the water's edge. Breakwaters length increased to 2123 m, which did not allow creating coastal sediment, whereby catastrophic erosion downstream appeared and has been developing

† Corresponding author

until now in the 5-7 km section of the coast north of the port. The prism of bottom sand was destroyed by the beginning of the 1930s, and by 1960 - 1970s the ruins of forts "came out" on the water's edge, causing abrasion of the second order the shore. Its pace increased from 0.7-1.7 m / year in the first 70 years to 3-4 m / year in subsequent years, operating the port. However, after a few stormy days, brow ledge erosion in some parts of the coast can be degraded by 4-9 m (0.5 m / day). In the XX-XXI centuries in this area the coast stepped ashore to ~ 200 m. In general, in the area of influence of blocking length > 40 km to the north from the port to cape Akmenrags prism coastal sand bottom volume > 70 million m³ diluted in half a century to the roof of boulder-block paleobench. In this case the loss of heavy mineral dispersion along the coast reached > 30 thousand tonnes (Bogdanov, 1993).

3. MINERAL RESOURCES ASPECT

Litorina rerash of the region are areas of coastal-marine titanium-zirconium placer. Repeated oscillations of the sea level led to the mobilization of heavy minerals (HM) of the material of the intermediate reservoir (moraine, fluvioglacial and limne-glacial deposits of pleistocene sediments and marine sediments of the Holocene) and the formation of a buried ancient concentrates and modern submarine placers (water depth 4-15 m). At the modern beach of accumulative shores, placers are not available, but there are parts of the abrasion. In this case, in the sands of Liepaja rerash, below the horizon of sanded peat lagoons are exposed and broken buried lenses and interlayers of inter-litorine concentrates HM (Bogdanov, 1999; Bogdanov, 2015). Modern deposits are formed in the rear of the beaches of remobilized abrasion of fossil HM concentrates, which are less productive than modern counterparts, but are close to them by the particle size (0.1-0.25 mm Cl - 61.5% and 45-75,5% , respectively) (Fig. 1).

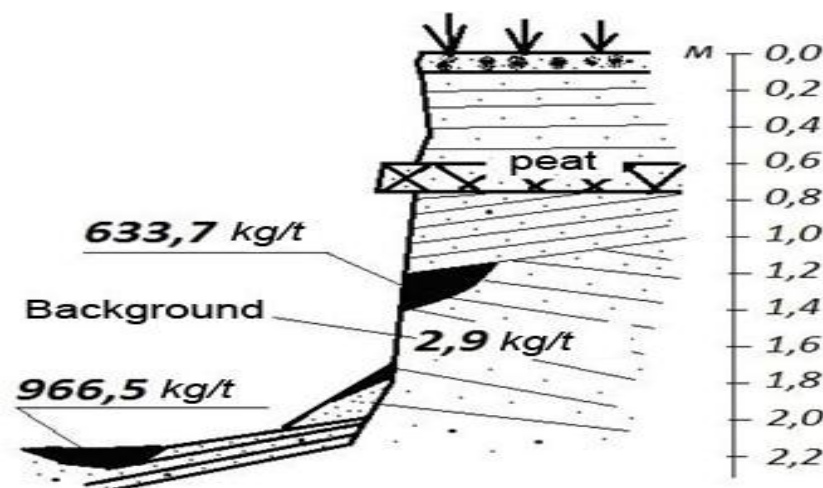


Figure-1. Ancient placer (concentrate lens buried in the ledge erosion of cumulative earlier accumulated shore), background (enclosing early-litorine sands) and modern beach placer. The total content of the heavy fraction: Liepaja, Shkedes spot (analysis of samples - laboratory mineralogical and track analysis GIN RAS).

Source: (Bogdanov, 2016; Bogdanov and Paranina, 2016).

Along the shores of the centers are distributed regularly. The most stable of their localization and HM enrichment (for removal of blank quartz sand) are inherent in beach area adjacent to the transverse underwater hollows, which is characterized by periodic development of discontinuous flows. Erosion of the coast here is more intense. Centers of industrially significant and comparable to concentrations ore HM with some similar placers of beaches of White Sea and North Sea, the ancient deposits of southeast Australia, but ephemeral by location and significantly inferior to them in the productive capacity of the reservoir. Concentrate contains ~%100 HM (99.42%). The stock (by weight) of deposits - 5.67 t (at a power of 0.03 m, width 3 m, length 30 m). In the most productive on the content of HM cells. 0.2-0.25 mm (98% or 2058 kg / m³) the amount of mineral ore are 72.5% or 1 523 kg / m³

(1130.4 - ilmenite, magnetite, 292.5, 54.2 - zircon, 22.9 - rutile, 22.5 - monazite and 0.6 - leucoxene) (Bogdanov, 1993; Bogdanov, 1999; Bogdanov, 2015).

4. ECOLOGICAL AND HYGIENIC CONDITION

The Baltic Sea has long been the scene of active human activity, including the military; this is one of the most polluted inland seas of European Russia (chemicals, radionuclides, etc.). Since the end of World War II underwater dumping of toxic chemicals (hazardous chemicals) from the arsenal of Nazi Germany has been located there. There are two major areas of such waste - Liepaja and Bornholm (localized type: 1946 flooded 30% of the entire stock of chemical weapons of Germany). Liepaja burial - concentrated placer of not localized type (Gotland, Liepaja hollows). Composition of hazardous chemicals: cyclon B (hydrocyanic acid), mustard, adamsit, chloracetophenon. Emplacement area should be dumped (Aibulatov, 2000; Aibulatov, 2005). The plot of soil dumps, seaward of the sea depth of 10 m (available for exposure to severe storms waves), with the possible disposal of the Nazi munitions of hazardous chemicals known north of the port of Liepaja. Dumping from maintenance dredging in the port took place regularly in the past by the Soviet Navy until the well-known events of August 1991 (Fig. 2).

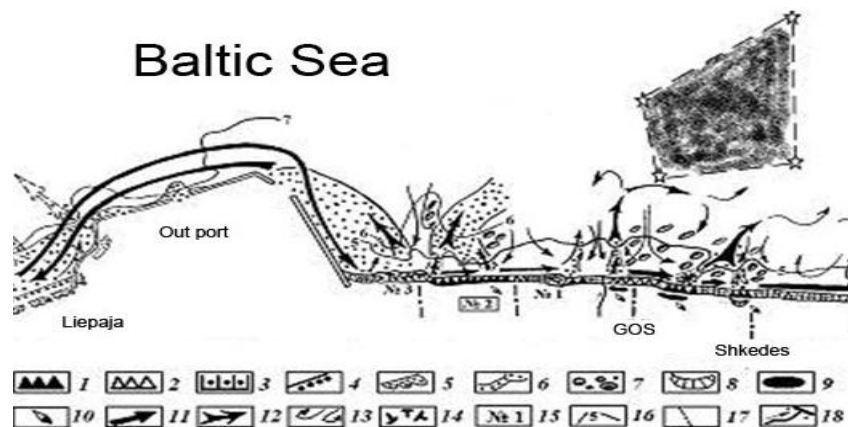


Figure-2. Anthropogenic morpho-dynamic anomaly area of the port of Liepaja: abrasion, beach placer and environmental aspects of the sea coast. Morpho-genetic shore type: 1 - bad, with catastrophic abrasion, 2 - abrasive-accumulative, with traces of episodic erosion, 3 - the same, with aeolian "cushion" in the rear of the beach, fixed oats sand, 4 - accumulative; 5 - wind-blown foredune ridge sand on the beach and rapidly renewable shallow outer harbor; 6 - bottom sand; 7 - rocky bottom; 8, 9 and 10 - indirect indicators of the dynamics of the coastal zone: micro-lagoon in the throat discontinuous flow, deposits of HM and buoys, plucked from the approaches to the port, respectively; 11 - average long-term trend of the transfer of matter and energy; 12 - removal of preferential zones of beach sand on the underwater coastal slope at 13 - at coastal-circulating cells; 14 and 15 - concrete ruins and number of batteries of fortress Libau, respectively; 16 - isobath, m; 17 - Contingent border links litodina-nomic subsystem anomaly; 18 - the mouth of small rivers and streams. GOS - municipal wastewater treatment plants. The dashed lines between asterisks - the ground dumping of a soil from the repair formation of scatterings made by the Navy of the USSR till 1991.

Source: (Bogdanov, 2016; Bogdanov and Paranina, 2016)

The Nazi grouping was liquidated there by Soviet troops - "Liepaja trap". Echoes of War expressed in the emission of beach of deadly "relics" - fascist shells and bombs in destroyed and "armed" condition, which are dangerous for adolescents, who play there. Some of the ammunition can be of chemically poisonous nature. The danger of such a "heritage" increases for: a) trawl fishing vessels, b) process of engineering, geological, mining and offshore operations, c) storm ashore. During the survey (Bogdanov, 1993) the sappers from Klaipeda were called repeatedly.

The area has experienced the consequences of the Chernobyl accident (summer 1986). The release of radionuclides captured part of the Soviet Baltic. Access to the beach of Liepaja was closed for some time; frontier zone adjacent shores is inaccessible to outsiders. Total activity, which has been taken to the Baltic Sea - 3.9×10^8 Ci. "Chernobyl trace" is being traced by the presence of man-made and extremely toxic product of uranium fission - ^{137}Cs

(sources - energy, nuclear weapons, etc.). It is firmly held by the soil organic matter, is being absorbed by the fine part of the soil and is incorporated into the crystalline lattice of clay minerals. It is known that ^{137}Cs penetrated into bedrock (basalts) to a depth of 3-5 cm (Budarnikov *et al.*, 1992). In the Baltic Sea in 1987, the layer (0-5 cm) of bottom sediments contained 3,400 Bq / kg ^{137}Cs . Penetration of the isotope in sediment thickness is up to 15 cm. In comparison, the bottom sediments of the southern inland seas, 1997-1998, were ^{137}Cs , Bq / kg. Azov - 100, Black (Anapa, Sochi) - 0.19 (average: background) (Aibulatov, 2000; Aibulatov, 2005).

Concentrate of modern beach placers, due to a significant content in the minerals (monazite, rutile, zircon), including uranium, thorium and other natural radionuclides (NRN), and due to technological developments, has been studied from the viewpoint of radiation hazards. An analysis of the concentrate is in the certified and accredited laboratory of STC "Amplituda" (A. P. Ermilov, Zelenogradsk, 25.05.2015). Among the diagnosed, radionuclide ^{137}Cs was found, whose sources in Liepaja district of LatvSSR and in the port did not exist.

It is important to note, concentrate until the selection from the beach (summer 1988, 2 years after the accident) was processed by exogenous processes: washed by sea water and precipitation, winds deflated, refilled material slightly humus coastal sandy soils in the collapse of the coastal scarp. Prior to the analysis, it was kept in a glass jar tightly packed 27 years (the period of half-life ^{137}Cs = 30.2 years).

A. With Regard to Natural Radionuclides

Effective specific activity (5668.6 Bq / kg) exceeded the allowable safe level (1500 Bq / kg) in ~ 4 times. Minerals of such quality belong to IV class of hazard: handling of them requires compliance with the radiation safety rules for people and the environment (SanPiN 2.6.1.2800-10).

B. Legacy of the Chernobyl Accident

Concentration of toxic ^{137}Cs was 32 ± 23 Bq / kg. During a disaster, taking into account the half-life, specific activity of the isotope in the soil on the banks and in deposits on the beach was about 2 times higher (> 60 Bq / kg, up to 110 Bq / kg). Weight loss of radionuclide in a given territory - 2-3 Ci / km². Soil organic matter coastal dune might contain ^{137}Cs > 200 Bq / kg, and peat of dune lagoon depressions - in 5-8 times more (up to 500 Bq / kg). The level of pollution in Latvia correspond to the values inherent in the time in Tula and Smolensk regions, but was higher than within the "Semipalatinsk trace" in the Altai (Vinokurov and Malgin, 1997; Sanarov *et al.*, 1998; Heavy, 2012; Meshkov *et al.*, 2012). Abrasion and aeolian toxic isotope separation on soil particles and in dissolved state aggravated pollution of the coastal strip.

5. BIOMEDICAL ASPECT

Despite the relatively good condition of the current radiation-ecological state of the studied coasts, it is important to bear in mind the consequences of such impact on human health and biota, including remote ones. The stable cesium is contained in organisms of humans and animals in amount of 0,002-0,6 mg / g of the soft tissue. Absorption of ^{137}Cs in the gastrointestinal tract (GIT) is 100%. Radionuclide accumulates in the jejunum, duodenum and ileum (76-78%); most of all - in the muscles. When respiratory receipts toxic isotope is secreted into the intestine and is reabsorbed in its downstream divisions. Entering into the blood, it is evenly distributed to organs and tissues. The radiation-contaminated areas of the Russian Arctic in the local population was dominated by a characteristic set of diseases: malignant tumors (lung, gastrointestinal tract, etc.), Endocrine disorders; forming organs diseases, upper respiratory tract, digestive system, urogenital system; nosology of genetic, cytomegalovirus and Chlamydia aetiology, etc. Cytomegalovirus infection (pathogen - DNA virus) is deadly dangerous for people with immune deficiency characteristic of those exposed to radiation. Infection after contamination, latently persists for a long time in the body, but in the end - leads to the development of mucoepidermoid carcinoma and other malignancies (Meshkov *et al.*, 2012).

6. CONCLUSION

The complex of this type of heritage on the studied part of the coast of the Baltic has negative and positive aspects. The latter includes the mineral resource aspect. However, from the medical and ecological point of view, the beach rare metal concentrates can be of certain hygienic threat. The negative point is complemented by coastal erosion.

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About Author (s):

Nikolay Aleksandrovich Bogdanov, doctor of geographical sciences, is the leading researcher of Institute of geography of the Russian Academy of Sciences in Moscow. Area of scientific interests: geomorphology, geoecology, environment geochemistry.

Alina Nikolaevna Paranina, candidate of geographical sciences, associate professor of faculty of geography of RGPU of A. I. Herzen. Area of scientific interests: landscape planning, ecology, culture geography.

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